OpenO&M Standards-based Live Interoperability Demonstration
ISA Expo – October 6-8, 2009
Houston, TX
Context for Collaboration: Bringing Enterprise Business Systems Together with Engineering and O&M Systems – Oil and Gas Upstream Model

Semantic Context

Enterprise Business Systems

Engineering & Construction
ISO 15926

Operations & Maintenance
ISO 18435
ISO 13374
IEC/ISO 62264

An Ontology with First Order Logic, Basis for Gaining Semantic Alignment; Focus on Class Level Information Management, Can store Unlimited Detail, Comprehensive Reference Data

Controls

Physical Assets

O&M Execution Environment: Registry, Schema and Services Centric; Focus on Instance and Event Data, Basic Models for People, Processes, Systems, Unique Assets and Relationships along with Associated Event Data and History
Semantic Context

Enterprise Business Systems

ISO 15926

Transform Engine

IRing

MIMOSA

OpenO&M

O&M Requirements Repository

Registry

Event Oriented Message Bus

Controls

Physical Assets

Context for Collaboration: Bringing Enterprise Business Systems Together with Engineering and O&M Systems – Oil and Gas Upstream Model
Silos Which Need to Communicate
Oil & Gas Portals / Business Applications

Business Intelligence

- Enterprise HR, Financial, Materiel, Logistics, & Mission Capability Data
- Production Optimization, Planning & Scheduling
- EPC P&ID Requirements & OEM Product Data
- Maintenance Breakdown Structure, Maintenance Work Plans, & Actual Failure Data
- Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data
Oil & Gas Portals / Business Applications

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Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data
Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data
Enabler #1: Guaranteed-Delivery
OpenO&M Information Service Bus
Oil & Gas Portals / Business Applications

Business Intelligence

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- O&M Registry Requirements Repository

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Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data
Enabler #2: OpenO&M
Common Interoperability Registry (CIR)
EPC P&ID Requirements & OEM Product Data

Enterprise HR, Financial, Materiel, Logistics, & Mission Capability

Production Optimization, Planning & Scheduling

Maintenance Breakdown Structure, Maintenance Work Plans, & Actual Failure Data

Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data
OpenO&M Common Interoperability Registry (CIR)

• Provides the “Yellow-Pages” lookup for all systems to locate an identical object in another system
• Glue to tie systems together which have different Identifiers for the exact same object but never had to talk “on-line” before
• Provides a globally-unique CIR Identifier (CIR Id) to link “local” object IDs
OpenO&M Common Interoperability Registry (CIR)

CIRRegistry

+ ID: IdentifierType
+ GUID: UUIDType
  + userDescription: TextType [0..n]

CIRRegistryCategory

+ ID: IdentifierType
+ categorySourceID: IdentifierType
  + userDescription: TextType [0..1]
  + ISO15926ObjectReferenceURI: IdentifierType [0..n]

CIRRegistryEntry

+ entityIDinSource: IdentifierType
+ sourceID: IdentifierType
+ CIRID: UUIDType
+ sourceOwnerID: IdentifierType [0..1]
+ userDescription: TextType [0..n]
+ userTag: CodeType [0..1]
+ inActive: IndicatorType [0..1]

CIRProperty

+ ID: IdentifierType
+ currentValue: CIRValueType [0..*]
+ dataType: CodeType [0..1]
+ UOM: CodeType [0..1]
+ mandatory: IndicatorType [0..1]

Examples

Registration Server A
Test Registry
Finance System Registry

Examples

OpenO&M Common Interop Registry (CIR) Model
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Release 0.4 (21-Apr-09)

Entity to store a small subset of properties that may be needed to link systems
together. It is not intended to be a global property master registry. The properties
may help in identification of equivalent entries. There are two predefined properties:

- **CIRParentEntityID**: Has the entityIDinSource for the parent object in the
  source’s hierarchy.
- **CIRChildEntityID**: Has the set of entityIDinSource for the child objects in the
  source’s hierarchy.

Examples

**CIRRegistry**

- ID: IdentifierType
- GUID: UUIDType

Examples

**CIRRegistryCategory**

- ID: IdentifierType
- categorySourceID: IdentifierType

Examples

**CIRRegistryEntry**

- entityIDinSource: IdentifierType
- sourceID: IdentifierType
- CIRID: UUIDType

Examples

**CIRProperty**

- ID: IdentifierType
- currentValue: CIRValueType [0..*]
- dataType: CodeType [0..1]

Examples

**CIRValue**

- ID: IdentifierType
- value: CIRValueType [0..*]
- dataType: CodeType [0..1]
- UOM: CodeType [0..1]
- mandatory: IndicatorType [0..1]
Oil & Gas Portals / Business Applications

Business Intelligence

OpenO&M Event-Oriented Message Bus

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Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data
Setting for our Demo
Today: Brand New Refinery
Finishing up Construction
Forever Infrastructure
Reinery A
Forever Infrastructure Refinery A Crude Unit Piping and Instrumentation Diagram (P&ID)
Use Case E1: Green-field Engineering Data Handover to O&M

**Current Business Problem:** Lack of good mechanisms for managing the needed information exchanges between EPC turnover activities and the O&M related systems, applications and technologies

**Capability Demonstrated in Booth:** P&ID Objects and Instrument Lists With Associated Process Requirement Information Automatically Transferred to O&M Systems Without Manually Re-keying of Data Using ISO15926 & OpenO&M Standards
Oil & Gas Portals / Business Applications

Business Intelligence

OpenO&M Event-Oriented Message Bus

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Production Optimization, Planning & Scheduling

EPC & OEM Engineering Product Design Data & Reliability Study Data

Equipment Breakdown Structure, Maintenance Work Plans, & Actual Failure Data

Control Systems, Data Historians, HMIs Equipment Health, & SHE Systems Data

ISO 15926 / IRING
Use Case E1: Green - field Engineering Data Handover to O&M
Use Case E1: Green

Engineering Data Handover to O&M

E105:2 (IT)
<table>
<thead>
<tr>
<th>Property</th>
<th>'Last In' Value</th>
<th>ISS</th>
<th>PID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Range To Unit of Measure</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td></td>
</tr>
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<td>Pressure Drop Density Max</td>
<td>890 kg/m^3</td>
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</tr>
<tr>
<td>Pressure Drop Density Min</td>
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<td>890 kg/m^3</td>
<td>890 kg/m^3</td>
</tr>
<tr>
<td>Pressure Drop Density Norm</td>
<td>890 kg/m^3</td>
<td>890 kg/m^3</td>
<td>890 kg/m^3</td>
</tr>
<tr>
<td>Pressure Drop Specific Gravity Max</td>
<td>0.891</td>
<td>0.891</td>
<td>0.891</td>
</tr>
<tr>
<td>Pressure Drop Specific Gravity Min</td>
<td>0.891</td>
<td>0.891</td>
<td>0.891</td>
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<td>0.891</td>
</tr>
<tr>
<td>Process Fluid Flow Rate at Max Flow</td>
<td>40 m^3/h</td>
<td>40 m^3/h</td>
<td>32 m^3/h</td>
</tr>
<tr>
<td>Process Fluid Flow Rate at Min Flow</td>
<td>25 m^3/h</td>
<td>25 m^3/h</td>
<td>25 m^3/h</td>
</tr>
<tr>
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<tr>
<td>Proportional Band / Gain</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
</tr>
<tr>
<td>Serial Number</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
</tr>
<tr>
<td>Service</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
</tr>
<tr>
<td>Sound Pressure Level at Max Flow</td>
<td>65.2 dB</td>
<td>65.2 dB</td>
<td>65.2 dB</td>
</tr>
<tr>
<td>Sound Pressure Level at Min Flow</td>
<td>77.9 dB</td>
<td>77.9 dB</td>
<td>77.9 dB</td>
</tr>
<tr>
<td>Sound Pressure Level at Norm Flow</td>
<td>69.4 dB</td>
<td>69.4 dB</td>
<td>69.4 dB</td>
</tr>
<tr>
<td>The flow-direction of this item is rele</td>
<td>False</td>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>Trace Heating</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
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</tr>
</tbody>
</table>
Oil & Gas Portals / Business Applications

Business Intelligence

OpenO&M Event-Oriented Message Bus

Enterprise HR, Financial, Materiel, Logistics, & Mission Capability Data

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O&M Requirements Repository

ISO 15926 / IRING

Control Systems, Data Historians, HMIs Equipment Health, & SHE Systems Data
ISO-15926
Oil & Gas Portals / Business Applications

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ISO 15926 / IRING

O&M Requirements Repository

O&M Registry

Control Systems, Data Historians, HMIs Equipment Health, & SHE Systems Data

Equipment Breakdown Structure, Maintenance Work Plans, & Actual Failure Data
### 1. Asset
- **Display Name**: STPR-2000-125
- **Asset ID**: 20
- **Enterprise ID**: 1029
- **Site ID**: 1
- **Serial Number**: 2000-125
- **Title**: ACME 2000 series stripper
- **Description**: Undetermined
- **Criticality Value**: 0
- **Last Modified On**: 2/6/2004 10:00:00 AM

### 2. Asset Type
- **Display Name**: Undetermined
- **Type Code**: 0
- **Description**: Undetermined
- **Database ID**: 0

### 3. Asset Readiness Type
- **Display Name**: Serviceable, Without Qualification
- **Type Code**: 1
- **Description**: New, used, repaired, or reconditioned asset which was commissioned
- **Database ID**: 1

### 4. Manufacturer
- **Display Name**: ACME MANUFACTURING
- **Enterprise ID**: 1029
- **Site ID**: 1
- **Manufacturer Code**: 1
- **Company Name**: ACME Manufacturing
- **International Fax Country Number**: 0
- **International Fax City Number**: 0
- **International Fax Local Number**: 0
- **International Phone Country Number**: 0
- **International Phone Local Number**: 0
- **Alternate Standard Industry Code 1**: 0
- **Alternate Standard Industry Code 2**: 0
- **Mail Address**: 0
- **Mail Address City Name**: 0
Oil & Gas Portals / Business Applications

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Equipment Breakdown Structure, Maintenance Work Plans, & Actual Failure Data

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Use Case E1: Greenfield Engineering Data Handover to O&M
Oil & Gas Portals / Business Applications

**Business Intelligence**

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ISO 15926 / IRING

O&M Registry

MIMOSA Equipment Breakdown Structure, Maintenance Work Plans, & Actual Failure Data

SAP PM

Control Systems, Data Historians, HMIs Equipment Health, & SHE Systems Data
## Display Equipment: General Data

### Equipment Information
- **Equipment:** PUMP-1500-632
- **Category:** Machines

### Status Information
- **Status:** INST
- **Valid From:** 05.10.2009
- **Valid To:** 31.12.9999

### General Data
- **Class:**
- **Object Type:** 3000
- **Object Type:** Pump
- **AuthorizGroup:**
- **Weight:** 0,000

### Reference Data
- **Acquisition Value:** 0,00
- **Acquisition Date:**

### Manufacturer Data
- **Manufacturer:** EMERSON
- **Model Number:** 1500
- **ManufPartNo.:** 632
- **ManufSerialNo.:** 3023-1228329
Current Business Problem: In remove/replace operations, there are limited automated methods to validate that a correct replacement part has been installed which meets the engineering requirements of the process. This results in situations where incorrect replacement parts result in costly failures and raise safety, health, and environment risks.

Capability Demonstrated in Booth: “Extended” Part Cut-Sheet Data is now electronically available in ISO 15926 and MIMOSA Format on-line to automatically compare against the engineering requirements data from the P&ID System without manually field-by-field review.
Open O&M Interoperability Demo OPC UA Server
Use Case E2  Flow Control Valve

<table>
<thead>
<tr>
<th>IN</th>
<th>OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter Limit</td>
<td>Current Meter</td>
</tr>
<tr>
<td>10000 Hours</td>
<td>5000 Hours</td>
</tr>
<tr>
<td>Increment Period</td>
<td>Maintenance Request</td>
</tr>
<tr>
<td>1 Hours</td>
<td>OFF</td>
</tr>
<tr>
<td>Increment Rate</td>
<td>Maintenance Request</td>
</tr>
<tr>
<td>1 Hours</td>
<td>OFF</td>
</tr>
<tr>
<td>Maintenance Reset Request</td>
<td>Total Reset Request</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Total Reset Request</td>
<td></td>
</tr>
</tbody>
</table>

FV01064
Use Case E2

Maintenance Request

Ready
<table>
<thead>
<tr>
<th>Property</th>
<th>'Last In' Value</th>
<th>CMMS</th>
<th>ISS</th>
<th>PID</th>
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</thead>
<tbody>
<tr>
<td>Operating Time To Close</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td></td>
</tr>
<tr>
<td>Operating Time To Open</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td>&lt;b&gt;</td>
<td></td>
</tr>
<tr>
<td>Output Range From</td>
<td>&lt;b&gt;</td>
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<td></td>
</tr>
<tr>
<td>Output Range From Unit of Measure</td>
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</tr>
<tr>
<td>Serial Number</td>
<td>&lt;b&gt;</td>
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<td></td>
</tr>
<tr>
<td>Service</td>
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</tr>
</tbody>
</table>
Current Business Problem: Data from operations on instrumentation and control devices is readily available, but is not easily turned into information to drive condition-based maintenance and operations. Predictive decision-making is thus difficult and not systemic throughout a plant resulting in costly, unplanned downtime and increased SHE risks.

Capability Demonstrated in Booth: Open CBM and Open CBO for I&C Devices
### Open O&M Interoperability Demo OPC UA Server

**Use Case M1 Pressure Sensor**

<table>
<thead>
<tr>
<th>IN</th>
<th>OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale Ramp Up/Down</td>
<td>Pressure</td>
</tr>
<tr>
<td>60 Sec.</td>
<td>26.0 PSIG</td>
</tr>
<tr>
<td>HI</td>
<td></td>
</tr>
<tr>
<td>50 %</td>
<td></td>
</tr>
<tr>
<td>LO</td>
<td></td>
</tr>
<tr>
<td>14 %</td>
<td></td>
</tr>
</tbody>
</table>

**PT01117A**

- Use Case M1
- Pressure Range: 0-100 PSIG
- Graph showing pressure trend over time
Equipment ID: PE01117A - Crude Tower Pressure Sensor

Date: 10/6/2009
Equipment: Pressure Sensor
Priority: HIGH
Status: Scheduled - Waiting for Parts
Functional Location: CDU1-PE01117A
Current Business Problem: Data from operations on critical rotating machinery (such as vibration and temperature readings) are also available through the control system, but are not easily turned into information to drive condition-based maintenance and operations. Predictive decision-making is thus difficult and not systemic throughout a plant resulting in costly, unplanned downtime and increased SHE risks.

Capability Demonstrated in Booth: Open CBM and Open CBO for Critical Rotating Machinery
Open O&M Interoperability Demo OPC UA Server

Use Case B1 Pump

IN
Alert Off Sec.: 420 Sec.
Alert On Sec.: 60 Sec.

OUT
Alert: OFF

01G-7A
Use Case B1
Vibration measurement from Dynamix on Pump 01G-7A
**Display PM Notification: Malfunction report**

**Reference object**
- **Functional loc.**: OIG-7A
- **Equipment**: PUMP-1500-632
- **Assembly**: 

**Responsibilities**
- **Planner group**: 4530
- **Main WorkCtr**: 
- **Person Responsi**: 
- **Person Responsi**: 
- **Reported by**: MTELLCBM
- **Notif.date**: 06.10.2009 14:48:21

**Subject**
- **Description**: CBM Event: Asset Health Alert for Vibrat
- **CBM Asset Health Alert Detected**

- **Tag Name**: 
- **Tag Value**: 
- **Rule Policy Tag Condition**: AVG([INSQL_VS107]:PumpFixed1_001.Pump.FV, '*-1h', '*') > 28 AND MAX([INSQL_VS107]:PlatformGR.CPULoadAvg, '*-1h', '*') > 40
- **Rule Policy Evaluate Condition**: 31.5127627259491 > 28.0000 AND 44.3868408203125 > 40.00

**Malfunction data**
- **Malfunct. start**: 06.10.2009 14:48:21
- **Malfunct.end**: 00:00:00
- **Breakdown dur.**: 0,00

**Breakdown**
- **Breakdown**: 

B110:2 (MT)
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